

What is claimed is:

1. A membrane electrolyte for a fuel cell comprising a first material for conducting protons from a first side of said membrane to a second side of said membrane and a second material for conducting gas from said first side of said membrane to said second side of said membrane.
2. The membrane electrolyte according to claim 1, wherein said first material comprises a first field of said membrane electrolyte and wherein said second material comprises a second field of said membrane.
3. The membrane electrolyte according to claim 2, wherein the first and second materials are bonded together.
4. The membrane electrolyte according to claim 2, wherein the first and second materials are mechanically fastened to one another.
5. The membrane electrolyte according to claim 1, wherein said first material and said second material are disposed on a plurality of third materials, and wherein said third materials are fastened together.
6. The membrane electrolyte according to claim 1, wherein said first material includes a plurality of openings and wherein said second material is positioned within each of said plurality of openings.
7. The membrane electrolyte according to claim 1, wherein said first material comprises a hydrophilic polymer having characteristics comprising a substantial affinity for water, a substantial proton conducting capacity, and substantial oxidation resistance.
8. The membrane electrolyte according to claim 1, wherein said first material comprises perfluorosulfonic substituted polytetrafluorethylene.
9. The membrane electrolyte according to claim 1, wherein said first material comprises NAFION®-Teflon®-phosphotungsti acid.

10. The membrane electrolyte according to claim 1, wherein said first material comprises NAFION®-zirconium hydrogen phosphate.
11. The membrane electrolyte according to claim 1, wherein said first material comprises Polyetheretherketone.
12. The membrane electrolyte according to claim 1, wherein said first material comprises polybenzimidazole.
13. The membrane electrolyte according to claim 1, wherein said first material comprises polyvaniladine fluoride.
14. The membrane electrolyte according to claim 1, wherein said second material comprises Zintex®.
15. The membrane electrolyte according to claim 1, wherein said second material comprises expanded PTFE.
16. The membrane electrolyte according to claim 1; wherein said membrane is coated with a catalyst;
17. The membrane electrolyte according to claim 1; wherein said first material is coated with a catalyst;
18. The membrane electrolyte according to claim 1, wherein said first and said second materials are combined to substantially form a single layer structure.
19. The membrane electrolyte according to claim 1, wherein said second material is divided into a plurality of portions which are spaced apart along said first material.
20. The membrane electrolyte according to claim 19, wherein said plurality of portions extend substantially the width of said membrane electrolyte.
21. The membrane electrolyte according to claim 19, wherein said plurality of portions extend substantially the length of said membrane electrolyte.

22. The membrane electrolyte according to claim 1, wherein said second material comprises a web of micromesh, and wherein said first material comprises a plurality of strips positioned intermittently along said second material.
23. The membrane electrolyte according to claim 1, wherein said first material is separated from said second material.
24. A membrane for a fuel cell comprising a first material for conducting protons from a first side of said membrane to a second side of said membrane and a vent having a first end in communication with said first side of said membrane and a second end in communication with said second side of said membrane, wherein said vent conducts a gas from said first side to said second side.
25. A membrane electrode assembly for a fuel cell system comprising:
- a gas-evolving, protonically conductive membrane electrolyte having a first side exposed to an anode chamber of said fuel cell system and a second side exposed to a cathode chamber of said fuel cell system, wherein said membrane includes a first material for conducting protons and a second material for evolving gas;
  - a first catalyst positioned proximate said first side of said membrane electrolyte;
  - an anode gas diffusion layer positioned proximate said anode electrode;
  - a second catalyst positioned adjacent said second side of said membrane electrolyte; and
  - a cathode gas diffusion layer positioned proximate said cathode electrode.
26. The membrane electrode assembly according to claim 25, wherein said anode gas

diffusion layer and/or said cathode gas diffusion layer comprises porous carbon.

27. The membrane electrode assembly according to claim 25, wherein said porous carbon comprises carbon fiber paper.
28. The membrane electrode assembly according to claim 25, wherein said porous carbon comprises a carbon cloth.
29. The membrane electrode assembly according to claim 25, wherein said anode gas diffusion layer and/or said cathode gas diffusion layer includes a thickness between approximately 150  $\mu\text{m}$  to 400  $\mu\text{m}$ .
30. The membrane electrode assembly according to claim 23, wherein said anode gas diffusion layer and/or said cathode gas diffusion layer is treated with an additive.
31. The membrane electrode assembly according to claim 30, wherein said additive comprises Teflon.
32. The membrane electrode assembly according to claim 25, wherein each of said anode gas diffusion layer and said cathode gas diffusion layer includes channels for directing gas to/from said second material of said membrane.
33. A fuel cell comprising a membrane electrolyte for a fuel cell comprising a first material for conducting protons from a first side of said membrane to a second side of said membrane and a second material for conducting gas from said first side of said membrane to said second side of said membrane, disposed within a housing.
34. A fuel cell comprising a housing and a membrane electrode assembly disposed within said housing forming an anode chamber and a cathode chamber, said membrane electrode assembly comprising:

a gas-evolving, protonically conductive membrane electrolyte having a first side exposed to an anode chamber of said fuel cell system and a second side exposed to a cathode chamber of said fuel cell system;

a first catalyst positioned proximate said first side of said membrane electrolyte;

an anode gas diffusion material positioned proximate said anode electrode;

a second catalyst positioned adjacent said second side of said membrane electrolyte;

and

a cathode gas diffusion material positioned proximate said cathode electrode.

35. A fuel cell system comprising:

a fuel delivery device;

a fuel source having carbonaceous fuel, said source in communication with said fuel delivery device;

an anode chamber having an inlet for receiving a fuel mixture from said fuel delivery device and an outlet for returning unreacted fuel to said fuel delivery device;

a cathode chamber having an inlet for allowing an oxidant to flow into said cathode chamber, a first outlet for exhausting gaseous effluent and a second outlet for directing water effluent to said fuel delivery device;

a membrane electrolyte positioned between said anode chamber and said cathode chamber, said membrane comprising a first material for conducting protons from said anode chamber to said cathode chamber and a second material for conducting gas from said anode chamber to said cathode chamber.

36. The fuel cell system according to claim 34, wherein said fuel source is internal to the fuel cell system.
37. The fuel cell system according to claim 34, wherein said fuel source is external to the fuel cell system.
38. A fuel cell system comprising:
- a fuel delivery device;
  - a fuel source in communication with said fuel delivery device;
  - an anode chamber having an inlet for receiving a fuel mixture from said fuel delivery;
  - a cathode chamber having an inlet for allowing an oxidant to flow into said cathode chamber and an outlet for exhausting effluent out of said cathode chamber;
  - a membrane electrolyte positioned between said anode chamber and said cathode chamber, said membrane comprising a first material for conducting protons from said anode chamber to said cathode chamber and a second material for conducting gas from said anode chamber to said cathode chamber.
39. The fuel cell system according to claim 38, wherein said fuel source is internal to the fuel cell system.
40. The fuel cell system according to claim 38, wherein said fuel source is external to the fuel cell system.